State of California
AIR RESOURCES BOARD

Research Screening Committee Meeting
Cal/EPA Headquarters Building
1001 I Street
Conference Room 510
Sacramento, California 95814
(916) 445-0753

October 15, 2009
9:00 a.m.

ADVANCE AGENDA

Interagency Agreements

1. "Health Effects of Central Valley PM," University of California, Davis, $496,429, Proposal No. 2688-265

   Epidemiological studies have demonstrated that respiratory and cardiovascular health effects are most associated with particulate matter (PM) levels one to three days prior to the advent of adverse health responses. However, the temporal patterns for development of pulmonary and cardiovascular responses appear to differ. Little is understood as to whether adverse changes in respiratory and cardiovascular endpoints represent independent effects that have different time courses for development, or whether they represent a continuum of effects that share common biological pathways and are inter-related. In addition, past studies have evaluated all endpoints at the same time post-exposure. Because of this, little is known about the time course for development of respiratory and cardiovascular effects. This project will involve a series of experiments in the Central Valley of California designed to investigate how time lags in exposure increase or diminish pulmonary and cardiovascular responses in a species of mouse model that has similar pulmonary and systemic responses to PM as are observed in humans. The hypothesis of this project is that local pulmonary inflammatory responses in the airways of the lung precedes, and then initiates vascular inflammation and subsequent platelet activation. Platelet activation is a key factor in formation of thrombi (clots) in the systemic circulation, leading to heart attacks and stroke, which are the among the leading causes of premature death that have been associated with PM exposure. The results of this project will provide critical data on the biological mechanisms through which PM adversely impacts health, and will specifically address the key question of the lack of concordance between respiratory and cardiovascular endpoints. This study will provide important information that will help to explain the biological basis of epidemiological associations between adverse health outcomes and PM, and provide needed biological support for state and national ambient air quality standards for PM.

2. “Determination of the Spatial Distribution of Ozone Precursor and Greenhouse Gas Concentrations and Emissions in the LA-Basin,” University of California, Los Angeles, $299,968, Proposal No. 2684-265

   Assembly Bill 32 (AB 32), which requires a reduction in emissions of greenhouse gases (GHG) in California to 1990 levels by 2020, presents a challenge to the existing observational network. The current network was designed to monitor air pollutants at ground level with the aim of estimating human exposures. New technologies are required for long-term monitoring of spatial concentrations and emissions of GHGs. The proposed research will develop novel remote sensing methods to map out three dimensional concentrations of trace gases and, combined with new inverse modeling techniques, to monitor emissions of air pollutants and GHGs in the South Coast Air Basin (SoCAB). Ultraviolet-visible and near-infrared (light) spectrometers will be installed at the Jet Propulsion Laboratory's (JPL) Mt. Wilson California Laboratory for Atmospheric Remotes Sensing located 1700 m above the SoCAB. These spectrometers will scan in three dimensions and provide concentrations of nitrogen dioxide (NO_2), formaldehyde (HCHO), glyoxal, sulfur dioxide, dimer of oxygen (O_4), aerosol extinction, carbon monoxide, and the GHGs carbon dioxide (CO_2), methane, and nitrous oxide (N_2O) with a time resolution of 30-60 minutes. The product will be a unique spatio-temporal description of concentrations and emissions within the SoCAB. This data will help support and improve the GHG emission inventory for AB 32 and lay the foundation for a next generation air quality monitoring network.

3. “Assessment of Baseline Nitrous Oxide Emissions in California’s Dairy Systems,” University of California, Davis, $82,000, Proposal No. 2682-265

   Nitrous oxide (N_2O) is one of the major GHGs generated from agriculture. It contributes approximately 3 percent of the total GHG inventory in California with an estimated 9 metric million tons of CO_2 equivalent ($MMTCO_2E$) emissions in 2006. There is great uncertainty in this estimation, however, because N_2O emissions from agricultural soils are extremely variable, dependent on numerous environmental and agricultural management factors. Quantifying N_2O emissions from California agricultural soils is vital to improving GHG emission budgets. Three ongoing projects, funded by the Air Resources Board (ARB), California Energy Commission, and California Department of Food and Agriculture, are characterizing N_2O fluxes in California cropping systems from synthetic nitrogen fertilizers. This study proposes to measure N_2O emissions from cropping systems that receive dairy waste, another important source of nitrogen (N) in California. The project will provide N_2O emission data from land-applied dairy waste sources and allow an estimation of baseline N_2O emissions from Central Valley dairy systems. The result will be an improvement of the overall California N_2O emission inventory.

4. “Determining NO_X Emissions from Soil in California Cropping Systems to Improve Ozone Modeling,” University of California, Davis, $83,500, Proposal No. 2683-265

   Nitrogen oxides (NO_X) are major air pollutants and can react with volatile organic compounds (VOC) under sunlight to form ozone, a principal ingredient of smog. Smog is harmful to both human health and the environment. Cropland is a known source of NO_X, but its contribution to California’s NO_X inventory has not been determined. An earlier study indicated that out of the world’s annual 190 million tons of NO_X emissions, about one third was produced from soils by microorganisms. In the intensively managed California’s cropping systems, nitrogen (N) fertilizers are regularly applied to the soil to boost crop yields. The increased level of N in the soil could enhance soil-induced NO_X. This project will measure soil NO_X emissions from a range of California’s cropping systems under various environmental and management conditions. The proposed study is an add-on component to three on-going nitrous oxide (N_2O) monitoring efforts. The results of the study are expected to provide an estimate of NO_X emissions from California’s agricultural soils and ozone modeling input by including NO_X emissions from the soil.

5. “Behavioral Strategies to Bridge the Gap Between Potential and Actual Savings in Commercial Buildings,” University of California, Davis, $134,981, Proposal No. 2685-265

   The proposed research addresses a critical gap in our understanding of the human dimensions that influence energy use and performance of energy-saving devices in buildings. Historically, State and Federal efforts to reduce GHG emissions through demand-side management of commercial buildings have focused on developing more efficient devices and structures, to the near-exclusion of addressing management strategies and occupant behaviors. The proposed work will make use of interviews, surveys, and participant observation in a diverse sample of commercial buildings in California to illuminate actual practices that influence energy consumption in buildings. Understanding these practices will help guide research and policy toward improved technology development, building design, and toward behaviorally-oriented conservation campaigns that fit, or can successively influence, actual social practices. Research results will also support development of new and potentially more powerful, more cost-effective, GHG emissions reduction strategies for commercial buildings with the co-benefits of protecting and even improving occupant health, productivity, and well-being. Although the focus of this research is on existing buildings as they currently operate, results can also be used to inform new building design and retrofits.

6. “Hourly In-situ Quantitation of Organic Aerosol Marker Compounds During CalNex 2010,” University of California, Berkeley, $249,999, Proposal No. 2680-265

   Many areas in California are out of compliance with air quality standards for fine particulate matter (PM2.5). Organic matter is a major constituent of PM2.5 mass on an annual basis. Quantitative, time-resolved knowledge of the composition of

organic particulate matter is necessary to trace PM2.5 sources, to understand the formation and transformation processes, and to evaluate the roles of various PM2.5 components in air pollution and climate change. To support air quality and climate change researchers and regulators, this project would make hourly in-situ measurements of organic species in particulate matter in the southern San Joaquin Valley (SJV) during CalNex to improve understanding of PM2.5 sources and related atmospheric processing (e.g., chemistry). The measurements will be made over a six-week period to document the atmospheric variations in response to fluctuations in meteorological conditions and to systematic variations in emissions with time-of-day. These observations will form the basis for analyses aimed at understanding the sources and photochemistry controlling PM2.5 production in the study region and thus allow ARB to design more efficient emission control strategies.

7. "Aircraft Measurements of the Vertical Mixing State of Soot Aerosols in California," University of California, San Diego, $400,000, Proposal No. 2689-265

   Particles in the atmosphere impact human health and climate, the former by inhalation, and the latter primarily by modifying radiative transfer in the atmosphere. Human health impacts occur in the lowest layers of the atmosphere, and are mediated by particle concentration, chemical composition, and size distribution. Climate effects are also modulated by particle concentration, chemical composition, and size distribution, but radiation effects also are driven by dry air light scattering by particles, the interaction between clouds and particles ("cloud brightening"), and by light absorption by particles. Unlike health effects, which are similar wherever the particles are inhaled, the location of the particles in the atmospheric column can modify the climate effects. This project will help meet one of the goals of the CalNex program, that of looking at both air quality and climate effects of air pollution over California, by adding measurements of particle properties from an aircraft. This will be the first time that these types of measurements will be made from an aircraft in California. Addition of this project to CalNex will be a significant improvement to efforts to characterize the effects of particles on air quality and climate in California.

8. "Improved Characterization of Primary and Secondary Carbonaceous Particles," University of California, San Diego, $255,000, Proposal No. 2681-265

   Carbonaceous compounds can constitute the largest fraction of PM2.5 in many regions, but their composition is usually the least understood. Better understanding and characterization of carbonaceous aerosols through improved measurements are needed in order to identify their emission sources and impacts on health, visibility, and climate. The proposed research will include measurements of organic mass (OM) concentration by Aerosol Mass Spectroscopy and Fourier transform infrared spectroscopy, as well as x-ray Fluorescence for elemental tracers. Since emissions of VOCs can produce organic PM by forming secondary organic aerosol (SOA), simultaneous measurements of VOC and organic PM will be performed to investigate the discrepancies between emission inventories and atmospheric measurements. These techniques allow not only quantitative characterization of the

organic composition of fine aerosol, but also identification of source categories and quantitative source contributions through the use of elemental tracers and positive matrix factorization analysis. This research is expected to provide useful new measurements and statistical analysis for developing air quality attainment strategies in California and for understanding the pathways leading to SOA that may also be of importance in climate change. The better characterization of organic carbon will also improve our ability to identify organic functional groups in particles that reduce air quality and harm health.

Standard Agreements

9. "AMAX-DOAS Trace Gas Column Observations from Research Aircraft Over California," University of Colorado at Boulder, $549,999, Proposal No. 2687-265

   The proposed research is a key component of the CalNex 2010 field campaign planned ARB and National Oceanic and Atmospheric Administration (NOAA), that will improve the understanding and characterization of sources and chemical processing of gaseous species and organic aerosols throughout California with emphasis on the SoCAB and SJV. This proposed project is to deploy the University of Colorado Airborne Multi AXis DOAS instrument (CU AMAXDOAS) on the NOAA Optical Remote Sensing TwinOtter research aircraft during the eight-week CalNex period and following for an additional four weeks. The AMAXDOAS will measure pollutant concentrations in and above the boundary layer, probing directly the horizontal and vertical distributions of NO_2, HCHO, O_4, and possibly glyoxal boundary layer columns over the SoCAB, SJV, and ocean. The measurement results will be used to test and constrain atmospheric models, validate satellite measurements, and provide improvements for models and validated satellite data for better management of air resources. The project will address aspects of emissions strength and atmospheric chemistry which are not only important scientifically but also of practical concern to the ARB for management of air quality.

Draft Final Reports

10. "Ultrafine Particle Concentrations in Schoolrooms and Homes," University of California, Berkeley, $300,000, Contract No. 05-305

    Ultrafine particles (UFP) may harm human health, but little is known about exposures and factors that play a role in causing elevated concentrations and exposures. This study aimed to increase the knowledge base regarding concentrations of UFPs in houses and classrooms and to better understand the factors influencing UFP levels in those indoor environments. Working in the San Francisco Bay Area, California, the researchers measured particle number concentrations; studied the sources of UFPs in houses and classrooms, including vehicle emissions from nearby major roadways and cooking and cleaning activities; measured co-pollutants; and assessed human exposure from UFPs indoors. The researchers identified four key findings: 1) UFP levels were much higher in indoor

environments when occupants were present than when they were not; 2) the portion of indoor UFP entering from the outdoors tends to be higher in classrooms than in homes; 3) indoor emission sources are important contributors to particle number levels in houses but not in classrooms; and 4) the daily average particle number exposures per person were much higher in houses than in classrooms. While important observations were made in this initial study of UFP in California homes and schools, the small single-location sample size does not fully represent conditions found in the many diverse types of homes, occupant activities, and regional differences across the state. The results suggest that ARB should consider possible future actions to reduce ultrafine particles when occupants are in houses and classrooms, methods to reduce indoor emissions from cooking appliances in houses, and approaches to reduce infiltration of outdoor particles into classrooms from outdoor sources.

11. "Impact of Reactive Halogen Species on the Air Quality in California Coastal Areas," University of California, Los Angeles, $166,964, Contract No. 05-307

    Air pollution in coastal areas remains an important challenge in California. In current airshed models, which form the basis in the development of effective air pollution mitigation strategies, the chemistry of air pollution is driven by hydroxyl radicals during the day and nitrate radicals during the night. Much less attention has been paid to the interaction between urban air pollution chemistry and chemical species of marine and coastal origins - in particular, reactive halogen species (RHS). The recently completed project, dubbed the California Halogen Field Experiment (CalHal), addressed this gap in knowledge by conducting field observations of RHS, their precursors, and their reaction products at Zuma Beach in Malibu, California. In this study, co-funded by the Coordinating Research Council (CRC), four groups, each with a unique expertise in RHS measurement, deployed a comprehensive set of instruments for the study. The measurements clearly showed the presence of RHS and their precursors at the Zuma site and in the SoCAB. Modeling results showed that the RHS concentrations were high enough to impact ozone levels in the range 3–8 percent. Further work is necessary to lower the uncertainties in the understanding of this chemistry and to construct suitable mechanisms for airshed models.

Interim Report

12. "Deployment of a Novel Aerosol Mobility/Mass Spectrometer for Quantitative Chemical Analysis of Organic Aerosols from Mobile Sources," University of Southern California, $245,339, Contract No. 06-330

    This interim report for Phase 1 of a project on the deployment of a novel chemical ionization mobility/mass spectrometer documents progress made in its construction. Several obstacles were encountered in the development of the unit, which have caused significant delays in testing and field deployment. Currently, a thermal desorption, chemical ionization spectrometer has been assembled and tested; and

an ion mobility cell has been developed in tandem. The completed instrument should provide unique in-situ, quantitative measurements of organic compounds in ambient fine and ultrafine aerosols, as well as in gases. Plans for the next phase of the project include incorporating the mobility cell with the mass spectrometer, further testing, and deploying the unit in several field studies. This work promises significant contributions to the understanding of the chemical composition and evolution of aerosols in the SoCAB, and to existing health, air pollutant formation, and climate change studies.

Other Business

13. Update on "Physiochemical and Toxicological Assessment of the Semi-Volatile and Non-Volatile Fractions of PM from Heavy- and Light-Duty Vehicles Operating With and Without Emissions Control Technologies," University of Southern California, $677,950, Contract No. 05-308